Learning from India: Defining Profitable DSM and ESCO Programs for a Utility

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ABSTRACT

Developing countries are supposed to be learning from countries such as the U.S. about how to optimize their utility operations and management. It is thus ironic that while the US utilities industry is being redefined by changes in the regulatory process, their counterparts in some developing nations are offering us models of how utility programs can enhance profitable operations when there is no regulatory process distorting it. This is the case with how utilities in the US viewed Demand-Side Management (DSM), a concept that moved from being a promising means for optimizing load and profitability in the early 1970's to being viewed as a code word for cost-raising mandated programs in the 1990's. Yet this latter view does not have to be the case, and the example of Ahmedabad Electric Company (AEC) in India offers a lesson for American utilities seeking to redefine customer services and maximize profitability. This paper reviews the development of economically profitable concepts of DSM in India, how a phased testing process changed their design, and how Energy Service Companies (ESCOs) were relied upon as a cornerstone of program implementation and success.

INTRODUCTION

Background: Evolution of DSM Concepts. It is worth remembering that back in the 1960's, many utilities were actively selling appliances and maintenance services, which offered them some short-term and long-term profit potential. While discount appliance stores later put pressure on this type of product sales, another trend also helped to undermine such sales. Instead of risking shareholder money to finance product sales and services, new concepts such as DSM (Demand-Side Management) offered a social and environmental justification for pushing sales and installation of efficient new equipment at a cost guaranteed to be underwritten by ratepayers. And so, a wide range of existing programs -- from customer education to equipment inspection and product sales -- were redefined as "DSM programs." Rebate and giveaway programs, which usually added to operating costs and electricity rates, were added --including giveaways of everything from lighting to microwave ovens.

Eventually, the rising cost of such rebates and giveaways, as well as the high cost of conducting the required monitoring and evaluation process, led to the image of DSM as costing money and raising rates. It is thus no wonder that "DSM" became a bad name to many utilities with the advent of price competition. Ironically, the origin of DSM was a means of increasing industry efficiency through a better match of supply and demand. That included load management activities such as valley filling, peak spreading, peak reduction and strategic load building – i.e., increasing sales where there is (low cost) idle capacity available and reducing needs for reliance on more costly and less-efficient peak power generation. Yet while many utilities in the US have cut back or eliminated their DSM programs, many of those same utilities have been eagerly seeking to acquire Energy Services Companies (ESCOs) or otherwise build up their in-house activities in the area of energy services. The development of both DSM and ESCOs in India offers an alternative definition for both concepts.

The Context in India. In countries such as India, there had never been any DSM programs, so the concept of DSM had neither positive nor negative connotations. The US Agency for International Development (USAID) could still define DSM as a means of promoting effective technology development in the energy industry and offer to provide that type of activity to countries such as India. The first pilot program for DSM in India was established at the nations's largest private electric utility company – Ahmedabad Electric Company (AEC) in Ahmedabad, India (population 3 million). To maximize the value of its investment in DSM development, USAID asked its contractor, IRG, Ltd., to review the status of its efforts there, the lessons learned, and needs for successful technology transfer to other utilities in the country. The lessons learned illustrate the pitfalls of the American definition of DSM, the limitations of an overly narrow definition of utility benefits, and the prospects that DSM can have for reducing power costs and increasing revenues and profits.

BACKGROUND: NEEDS AND OPPORTUNITIES FOR THE UTILITY

The Company. Ahmedabad Electricity Company (AEC) is the largest private electric utility in India. It was originally established in 1913 by the British firm Killick Nixon Ltd. and has since grown to supply 820,000 customers with 2.5 billion kWh of electricity, meeting a peak demand of 575 mW. With a load factor of 70%, AEC's existing coal-fired power plants are sufficient to meet base load but fall short of meeting peak load requirements. Overall, AEC purchases 10% of its total power requirement from outside plants at a premium price, and the company actually loses money on that power. Thus, the utility has a strong financial incentive to expand its effective capacity and reduce its peak power importing requirements while increasing its off-peak sales.

Paradigm Shift for DSM. When USAID approached AEC with the offer of helping them initiate a pilot DSM program, it was the prospect of increasing economic efficiency, rather than environmental or social considerations, which was most attractive. Since there are no requirements or financial incentives for DSM in India, any such programs had to be justified as being in the economic interest of the utility. Since there are also no mechanisms available for cost recovery via government subsidy or the base electricity tariff, all DSM costs (beyond the USAID pilot support) would have to be paid by utility investment, customer payment and/or third party investment. In that context, the only financially viable and sustainable DSM activities will be those that make economic sense for the associated costs to be incurred by the utility, its customers or third parties. Each of these possible financing parties can have a different potential profit justification for investing in such programs:

- utility customers –cost may be paid directly by the customer when there is the prospect of a disposable income benefit, to be received through saving money on energy bills (from reduced consumption) and /or enhancing equipment performance and life (from improved power quality);
- the utility company –cost may be paid through the utility's own investment when there is the prospect of a net revenue benefit, to be received as a consequence of reduced actions to address peak demand (outside power purchases, investing in new power plants or curtailing power), reduced power theft, or increased revenue (from additional services provided or electricity sold).
- third parties –cost may be paid through investments by manufacturers or service providers when there is the prospect of a revenue benefit, from expanded sales of their products or services.

The fourth possible financing party – the government, was not an option, and there was no public mechanism available for subsidizing program costs to achieve other environmental or social goals. Since the program was being operated by the utility, there had to be either a direct economic benefit to the utility or else an indirect economic benefit as a consequence of customer or third party participation. That represents a paradigm shift from criteria typically defining DSM in America.

Program Evolution. The evolution of DSM at Ahmedabad Electric Company (AEC) illustrates four phases in the development of an ongoing and viable customer program in India: (1) Research Investigations, (2) Pilot Testing, (3) Full-Scale Program and (4) Ongoing Refinement. The elements of these phases are illustrated in Figure 1. There was a significant learning process at each phase with surprises along the way for both American consultants and Indian administrators, illustrating the opportunities for redefining objectives and priorities to adapt DSM to be economically viable in this setting. These lessons learned are described next.

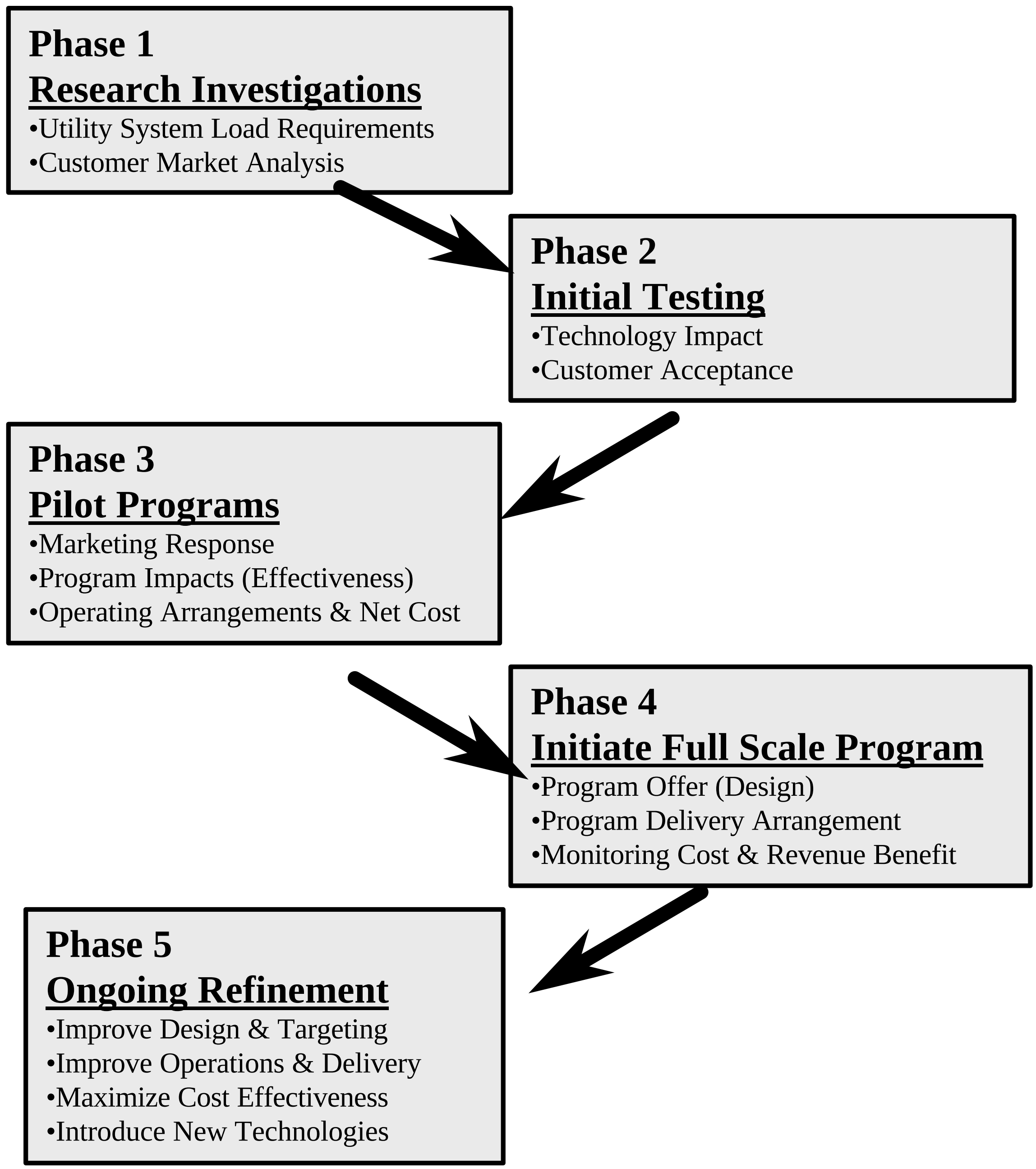

Figure 1. Phases for Development of a Profitable ESCO/DSM Program

PHASE 1. FEASIBILITY RESEARCH & TARGETING

The first phase (occurring in 1994-1995) involved collection of information necessary to ascertain utility goals and potential opportunities for use of DSM as a means for improving "system performance." Starting in 1994, USAID and its original consultant contractor (RMA) worked with AEC to conduct: (a) feasibility screening process, (b) load research and (c) market assessment.

Screening Process. The original USAID contractor initiated a program screening process using multi-attribute decision analysis. The final results was the identification of 31 potential DSM programs, including various education, audit, rebate, dealer incentive and pricing programs focusing on promoting energy efficiency and load control. These programs met the screening criteria for being readily implementable at modest cost and applicable to a significant market of customers. They included a variety of subsidy and rebate programs which would be attractive to customers but which unfortunately had no party willing to subsidize it. It became clear early on that AEC, as a privately-owned electric utility, had a responsibility to its shareholders to engage in economically viable activities which provide a return on its investment. From the viewpoint of AEC, DSM activities that improved the environment and improved customer well-being were attractive only as long as they also improved the company's own electricity system performance and its economic performance. Thus many of the types of rebate, giveaway and direct install programs popular in the US were immediately eliminated from contention by the utility.

Load Research. As part of the initial DSM research, USAID sponsored the purchase and installation of 72 load research (time-of-use) meters. While originally intended for use in end use load research and overall load forecasting, they ended up being most useful for a totally different purpose -- detection of power theft. For Indian utilities such as AEC, power theft is a significant problem that reduces effective system capacity available for sale to paying customers, adds to the peak power purchase requirements and fails to generate any offsetting revenue. Meters were also useful in confirming the prevalence of commercial and industrial customers who were not meeting the 0.85 power factor requirement and hence were putting an additional strain on system capacity as a result of their reactive power demand. For such customers, AEC could add a power factor surcharge or see that the customer acquires the necessary capacitor equipment to improve its power factor.

The meters provided AEC with a means of increasing its potential revenue base, which was more important to the utility than the basic research intended by the original US consultants. In fact, the success of the metering demonstration subsequently led AEC to purchase another 600 meters and later another 2000 more, for installation at commercial and industrial customers. (Plans call for 6000 meters to eventually be purchased.) That effort was found to have substantial value for enhancing company revenue and resource utilitization, even though it was no longer viewed as an element of DSM.

Market Assessment. AEC and consultant staff assessed the extent to which various types of customers contribute to their peak load problems, the number of such customers and feasibility of reaching those customers. They agreed that three market segments stood out as creating a significant share of AEC's total power demand and reactive power requirement. They were: (1) the hundreds of high-rise apartment buildings with water pumping to reserve tanks during the morning, (2) the hundreds of local flour mills with motors operating all day and (3) the municipal water system which has hundreds of pumps throughout the city. All of these markets involve motors. The higher reactive power requirement associated with these motor operations causes AEC to experience higher transmission and distribution system losses, thus limiting the company's effective capacity and increasing peak period needs for purchasing outside power. This can also cause customers to suffer more internal voltage drops (from motor startups), leading to hotter-running machinery with greater motor wear. Based on analysis of the customer market and its impact on AEC's system performance, target customer groups were identified for initial testing. The decision to engage in initial testing was, in hindsight, extremely important for (as explained in the next section) it showed that many of the expected opportunities identified from initial market assessment were *not* borne out.

PHASE 2. INITIAL TESTING AND PROGRAM DESIGN

Initial Testing. The second phase (occurring in 1995-1996) was the initiation of small-scale testing to confirm the applicability of the program concepts. These were experimental efforts in which a product was offered to a small set of customers, to test whether there is customer interest in the offering, and whether installation or adoption of it has the expected impact. The pilot efforts were: (1) installation of high efficiency water pump systems at high-rise apartment buildings, (2) installation of high efficiency motors at flour mills, and (3) installation of large high efficiency water pumps and capacitors at municipal wells. There was also broader testing including energy audits of 27 industrial customers and lab testing of locally rewound motors. The results indicated a number of surprises:

- The high rise apartment water pump installations (replacing pumps, pipes valves, and installing capacitors) showed substantial energy savings (30% - 45%) and demand savings (35% - 63%), with payback of less than one year. However, while 75 buildings were interested enough to have energy audits completed, only 4 buildings initially went ahead with the recommended retrofit installations due to a lack of financing to pay for the up-front cost faced by the cooperative associations operating the buildings.
- The flour mill installations (replacing motors and belts, installing capacitors and adjusting mill speeds) showed limited customer interest (only 4 participants) and only modest energy savings (2% - 5% from maintenance, 1% - 10% from drive belts and 10% from motor replacement). That was not enough to justify program initiation.
- The municipal well installations (replacing pumps and pipes, renovating bowls and installing capacitors) showed promising results (20-30% improvement for the two well sites), with payback of less than one year. That caused the municipal water agency to initiate its own program for pump upgrading, working in conjunction with the utility and USAID's Sustainable Cities Program.
- The motor testing showed that improved rewinding techniques could enhance the efficiency of rewound motors by a modest 2% - 4%; not enough to justify a program.
- The industrial energy audits revealed potential savings of 8% - 12% from a complex range of energy efficiency measures. That was not enough to justify rolling out an equipment replacement program, although the findings also indicated a broad need to address poor load factor. That led to the development of a program for assisting and enforcing expanded installation of capacitors.

Implications for Program Design. Thus, it became clear that some programs which appeared good from market research (such as the motors and flour mill programs) should ***not*** be initial priorities after all, while others (i.e., the apartment building program) could only work well if offered with additional financing available. Yet others could be taken over solely by the customer (in the case of the municipal water system). And still other opportunities which were not originally identified as energy efficiency opportunities (i.e, capacitor installation at industrial sites) could be justified (as DSM) on the basis of their system enhancement value to the utility.

PHASE 3. PILOT PROGRAMS

Design of Pilot Programs Using Outside Contractors. The third phase (occurring in 1996-1997) implemented pilot programs. AEC staff realized early on that they did not have the staff or the expertise to fully conduct customer outreach, energy audits and equipment installation activities. They rejected the options of expanding internal staff, initiating a subsidiary to conduct energy services, or purchase an existing firm for those purposes. Instead, they chose to focus on their core competency in producing and selling electricity, and instead utilize strategic partnerships with outside firms to carry out the marketing, equipment sales, installation and maintenance associated with energy efficiency. Thus AEC sought out business relationships with Energy Services Companies (ESCOs).

Roles of Energy Service Companies. The term ESCO can refer to many different types of companies engaged in the analysis and installation of efficient, energy-saving equipment. The National Association of Energy Service Companies in the US defines an ESCO as:

> "a business that develops, installs, and finances projects designed to improve the energy efficiency and maintenance costs for facilities… Typically, they offer the following services:
>
> - develop, design, and finance energy efficiency projects;
> - install and maintain the energy efficient equipment involved;
> - measure, monitor, and verify the project's energy savings; and
> - assume the risk that the project will save the amount of energy guaranteed....
>
> ESCOs employs a wide array of cost- effective measures to achieve energy savings. These measures often include the following: high efficiency lighting, high efficiency heating and air conditioning, efficient motors and variable speed drives, and centralized energy management systems." ("What is an ESCO?," www.naesco.org, 1997)

The narrow definition of an ESCO adopted by NAESCO encompasses only those firms that offer comprehensive solutions, covering essentially all of the above list of services and above types of energy-saving equipment. Yet others define the ESCO industry more broadly, encompassing firms that offer at least some of the above services for one or more of the above types of equipment.   That would thus also include many engineering firms, equipment installation contractors and subsidiaries of product manufacturers who also offer analysis, installation and maintenance services.

There are several key differences between the ESCO concept in countries such as the US which have a history of government-mandated DSM, and countries such as India in which there is no such precedent. In the US, various divisions and subsidiaries of utility companies have offered energy services as the implementation providers of utility-sponsored DSM programs. More recently, a growing number of utility companies have bought out independent ESCOs which started out as engineering and installation contracting firms. In contrast, the subsidiaries of equipment manufacturers have worked to serve a different sub-market where they sell their products and services directly to large business customers.

In India, where there have never been government- mandated DSM programs, there has been no constraint on the development of business partnership agreements between individual product manufacturers and private utilities. Thus, in India, equipment manufacturers have vertically integrated some operations to offer energy audit, equipment sales, installation, maintenance and financing services. This includes Saha Sprague Ltd. (SSL), manufacturer / provider of capacitors, and Asean Electronics Ltd. (AEL), manufacturer / provider of fluorescent lighting and capacitors.

ESCO - Utility Relationships. Following up from its initial testing, AEC contacted equipment providers and installers concerning their interest in participating in its pilot programs. Results were as follows:

- High-Rise Apartments. For the High Rise Water Pump program, AEC was not immediately able to find any equipment provider willing to take on the full marketing, sales, installation and financing package. That was due in part to the limited size market (up to 75 for the initial pilot) and also due to the complex, customized nature of each installation (requiring engineering design and equipment costing several thousand dollars). AEC did successfully find contractors to conduct the energy audit, specify equipment and then follow up by acquiring and installing new equipment. However, AEC still had to conduct the initial customer contact and it had only a small revolving loan fund for short-term financing. Given the limited financing, only 10 additional apartment buildings (out of 75 initially audited by AEC contractors) chose to have their equipment upgraded as part of the pilot program.
- Reactive Power Management. AEC was successful in getting manufacturer-owned ESCOs to operate the capacitor program aimed at industrial customers. That was made possible by the fact that the equipment requirement was formally prescribed by customer size and the market potential was broad (500 for the initial pilot, with a market potential of thousands more). Both SSL and AEL agreed to provide equipment leasing, installation, and maintenance of capacitors, with ownership reverting to the lessee (customer) at the end of the 3 or 5-year lease period. The utility's initial role was outreach -- to identify industrial firms with a low power factor and notify them of the need for them to acquire a capacitor to address the problem. The ESCO would then follow up with the equipment offer, and the utility's only role after that would be to collect the lease payments (on behalf of the ESCO) through its customer billing system.
- Lighting. While lighting was not initially included in the list of candidate DSM programs, utility conversations with one of the ESCOs (AEL) indicated interest in also offering a similar lease/sale program for high efficiency fluorescent lighting to resident of subsidized housing. The lighting fixtures included a 38W lamp/ electronic ballast combination with a leading (>1) power factor, in place of the standard 55W arrangement (with a low power factor). The utility agreed to provide a target customer list to the ESCO, which would then follow up by these households were offered free installation and use of the lighting equipment for six months, after which time they would have lease payments assessed through their electricity bills. The pilot was set to cover 200 households.

Pilot Experience. These pilot programs provided AEC with much useful experience. The High-Rise Apartment pilot provided the utility with experience working with contractors, developing a proven set of application forms and audit procedures, and experience demonstrating the customer benefits in terms of bill reduction. It demonstrated the potential economic benefit to the utility, in terms of reducing reactive power load and increasing the effective morning peak capacity. It also helped to define remaining needs for a successful program – to address the economic barriers to enrollment of apartment buildings in that program, by providing multi-year financing in the future.

The Capacitor and Lighting pilots demonstrated the utility's ability to work with manufacturer ESCOs for marketing, installation and leasing. For both programs, the pilots refined the utility's own procedures for customer targeting and lease billing procedures, as well as the installation protocols and performance levels it required of the ESCOs. They demonstrated customer interest in participation, and the capacitor program showed the effectiveness of actively promoting customer compliance with power factor requirements. They further demonstrated the potential economic benefit to the utility from both programs, in terms of reducing reactive power load and increasing the effective mid-day and evening peak capacity, as well as generating fees for lease billing on behalf of the ESCO.

PHASE 4. FULL PROGRAM ROLLOUT

The fourth phase (occurring in 1997-1998) rolled out full-scale versions of the three pilot programs, with the intent of having system-wide impacts. The programs all focus on achieving economic three goals: (1) net capacity and revenue expansion for AEC, (2) customer savings through power quality improvements and (3) customer bill reduction.

ESCO Contracts. AEC signed contracts with two manufacturer ESCOs to provide large-scale capacitor and lighting installations, under arrangements whereby AEC provides customer lists, a billing (revenue collection) mechanism and some marketing assistance, while the ESCO is responsible for the customer contact, equipment installation, maintenance and lease/sale. As of early 1998, the status of planning for each of these programs is as follows:

- High Rise Apartment Program – AEC is still seeking one or more ESCOs to implement this program. No ESCO has yet signed on, due to the limited market for this energy efficiency measure and the more customized nature of the audit and installation process (compared to the other two programs). The backup plan is for AEC to continue to market the program and arrange for contractors to install the equipment as it has under the pilot phase. The initial 1998 goal is to expand the program from 14 to 50 sites; the eventual goal is to expand the program to 1000 of the total 4000 residential high-rise buildings in AEC's customer base.
- Reactive Power Management (Capacitor) Program – At the end of 1997, AEC signed agreements with the two ESCOs already involved in the pilot program of capacitor installation at industrial sites. Under those agreements, the ESCOs will sign up customers for leasing of the designated equipment, install that equipment, maintain it over the 3 - 5 year lease period, and turn over ownership to the customer at the end of that period. AEC will continue to support the program effort by providing customer lists to the ESCO and collecting the lease payments (on behalf of the ESCO) through its billing process. The target is to install capacitors at 20,000 industrial sites; the current agreements cover 8,000 sites.
- Residential Lighting Retrofit Program – – At the end of 1997, AEC signed an agreement with the existing pilot ESCO to expand the lighting program into a large-scale effort for fluorescent tube lamps, and was hopeful of eventually also signing on a second ESCO (representing another lighting manufacturer). As with the industrial capacitor program, the ESCOs will sign up customers for leasing of the designated equipment, install that equipment, maintain it for the lease period and turn over ownership to the customer at the end of that period. AEC will continue to support the program effort by providing customer lists to the ESCO and collecting the lease payments through its billing process.

Utility Benefits. These DSM programs of AEC, by improving load management, are one step towards reducing the excess costs associated with inadequate peak electricity supply. The capacitor, lighting and water pump programs all include additional expenditures for end user equipment to reduce reactive power demand, thus reducing line losses and voltage reductions and effectively increasing the electric system capacity to meet peak power demand. The lighting and water pump programs also include expenditures for more efficient equipment retrofits, which can also reduce overall energy demand during peak periods. In all of these cases, the utility can benefit financially, as it can sell more peak period electricity (due to effectively increased transmission and distribution system capacity) and reduce its needs for importing expensive power during those periods. There is also a gain in fees paid to the utility as a share of its billing collection on behalf of the ESCOs. These should lead to financial gains for the utility despite a slight loss of some energy sales attributable to more efficient lighting and water pump systems.

Customer Benefits. While the customer pays costs of the installed measures (except for residential capacitors), the customer also benefits from money savings associated with reduced energy consumption, better equipment performance and longer motor life. In the case of the lighting and high rise residential water pump programs, it is possible to directly calculate the customer cost savings associated with reduced electricity consumption (resulting from substitution of more efficient equipment). However, the additional customer benefits associated with capacitors (installed under the capacitor program as well as the lighting and water pump programs) occurs in the form of enhanced equipment performance and life – benefits which have not been quantified at this time.

ESCO Benefits. The Energy Service Companies are taking on financial risks associated with their agreement to absorb costs of customer outreach, equipment installation and maintenance (during the lease period), but they expect to more than offset those costs through revenues generated by equipment sales and leasing.

LESSONS LEARNED FROM THE EXPERIENCE IN INDIA

The experience of DSM development at Ahmedabad Electric Company (AEC) in India leads to four lessons for technology transfer and program replication at other utilities:

- <u>Focus on Profits.</u> Since there was no mechanism for recovery of DSM program costs in the electric rate base, nor any requirement to incur costs for social or environmental purposes alone, the utility focused on DSM program activities that had economic value to the utility (as well as value to society). Such activities are possible. For AEC, they were measures focusing on (1) increasing distribution system efficiency, (2) raising revenue, and (3) accommodating or modifying peak demand to reduce costly purchases of outside power. These DSM activities did not focus solely on promotion of energy-efficient equipment, but also included actions to reduce power theft, improve power factor and generate additional fees for billing services conducted on behalf of ESCOs.
- <u>Use of a Phased Strategy.</u> There is significant value in the phased approach adopted by AEC, in which there is a progression from (1) research investigation to (2) initial testing to (3) pilot programs to (4) full-scale implementation. This incremental approach helped to prove the value of DSM to the company, in terms of direct financial benefits (e.g., expanding effective system capacity) and spillover benefits (e.g., using load research meters to reduce theft of power). It also allowed the utility to make significant changes in the program mix and design, which ended up being very different from the set initially identified by screening and market assessments. The process of initial testing was particularly important in refining the set of appropriate DSM programs for the local area, before moving to pilot programs (e.g., findings that the flour mills were not a high priority for program development, despite initial expectations that they would be a good target). The subsequent pilot program step was also important in working out issues concerning program design and delivery, before moving on to large scale implementation (e.g., refinement of the financing arrangement for residential water pumps, as well as negotiation and testing of working relationships with ESCOs).
- <u>Partnership with ESCOs.</u> The outsourcing of program delivery to ESCOs was attractive to the utility because it minimizes the extent of utility staff and capital resources needed for program

delivery. It also allowed the utility to achieve a more cost-effective and sophisticated approach to energy management by relying on the experience and expertise of the ESCO staff. The selected ESCOs (and others being considered by AEC) were associated with manufacturers of energy efficiency equipment. By vertically integrating product sales, service and financing functions, they can internalize costs of DSM program marketing and operation in return for potential revenue from equipment sales and leasing. AEC succeeded in demonstrating that ESCO / utility partnerships can be made to implement some types of DSM programs.

- Offer of Financing.   Customer demand for products and services to reduce energy costs exist for all customer segments and all income levels. This was demonstrated by acceptance of AEC's programs reaching industrial and commercial customers, a government agency and residential customers in both moderate income and low income housing developments. For nearly all groups, financing equipment cost is a factor defining market acceptance, and the availability of lease/sale arrangements in two of the programs was an important factor in their success. Conversely, the lack of long-term financing was limited acceptance of another program. AEC was successful in lining up ESCO leasing for large standardized products; the challenge will be to expand such arrangements to also cover more expensive, customized measures for smaller markets.